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Fault Lines: Earthquakes, Insurance, and Systemic Financial Risk

The fault lines from a major earthquake in Canada could quickly spread through the insurance industry and have a systemic financial impact. Policymakers should take several steps now to avert this chain of events.

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The Study In Brief

The fault lines from a major earthquake in Canada could quickly spread through the insurance industry and have a systemic financial impact. Policymakers should take several steps now to avert this chain of events.

Since the financial crisis of 2007/08, policymakers have focused on systemic risk to financial and economic systems, with most of the attention on the banking system. The framework for these efforts has been to build resiliency and shock absorbers to minimize the impact of financial shocks on the real economy. The inevitability of an earthquake in Canada poses a similar systemic financial risk for the insurance industry and the economy as a whole, and similar remedial efforts are required.

A federal emergency backstop arrangement for property and casualty insurers, properly designed, would minimize the systemic financial impact resulting from such a catastrophic and likely uninsurable event on those affected and on the economy at large. The moral-hazard implications appear small compared to the benefits of avoiding serious systemic risk. The backstop arrangement should, however, apportion costs, including a possible tranche of further contingent risk-sharing with industry in a way that lessens moral-hazard issues. A federal last-resort backstop guarantee could kick in beyond an industry-wide trigger of expected losses, say those associated with a one-in-500-year earthquake – currently approximately $30 billion to $35 billion. This loss estimate would be updated periodically, and the trigger could be set somewhere in excess of the one-in-500 threshold to promote further industry risk-sharing.

That said, as part of any Canadian reform package, it is important to bolster the Property and Casualty Insurance Compensation Corporation to deal with insurance industry problems and reduce systemic impacts from severe catastrophes. This would also reduce the likelihood that a federal financial commitment would be triggered and, if triggered, would have minimum costs. Having more tools available in advance to deal with catastrophic events would reduce post-catastrophe disaster claims. This *Commentary* recommends the following:

- Strengthen PACCIC so it can intervene before insurance companies in financial difficulty become insolvent.
- Ensure PACCIC has the capability to borrow to reduce its liquidity needs in a crisis.
- Following these structural changes, PACCIC should rerun its scenario models to examine how much that could increase resilience to extreme events.

Furthermore, insurance industry bodies, as well as the federal and provincial governments, should undertake awareness programs to enhance homeowners' understanding of catastrophe risks. This should encourage Canadians to evaluate the merits of disaster insurance coverage, particularly in the Quebec City-Montreal-Ottawa corridor where such insurance penetration is far too low.

Finally, the insurance industry, under active OSFI supervision, should further develop its models for setting aside adequate capital and claims-paying capacity. Regulators should ensure there is an adequate degree of conservatism and that models are as up to date as possible. OSFI should regularly assess the adequacy of major insurers' models, as they have done in the banking industry.

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Inevitably, a major earthquake will strike Canada – and it will likely be the largest natural disaster the country has faced.

Beyond the immediacy of the crisis, the impact of such a catastrophe on the financial system needs to be understood and assessed so that systemic risks do not exacerbate an already challenging situation.

Currently, well-known backstop arrangements exist for the banking industry. Indeed, systemic resiliency of the banking system has been a preoccupation of policymakers since the 2008 financial crisis. However, such formal protection from the impacts of natural disasters is non-existent. For their part, severe quakes would affect all economic players, in particular those who fund or insure commercial, municipal or residential housing infrastructure. Canada's property and casualty (P&C) insurance industry has warned that a catastrophic earthquake could overwhelm its ability to meet claims, thereby undermining insurers' ability to satisfy their obligations to other personal and commercial policyholders across the country, deepening the quake's economic aftershocks.

In many ways, Canada is ahead of other jurisdictions in financial preparedness for such an event, but there is a financing gap for the most extreme possibilities. How should Canada deal with this potential systemic financial risk? Is there a case for federal involvement? Could the private sector do more? How should the new finance minister look at this issue? This *Commentary* addresses these questions.

It concludes that earthquake damage at the catastrophic level is an uninsurable risk that is currently not adequately covered. Therefore, government needs to address gaps in the existing Canadian insurance scheme to ensure that a severe tail-risk earthquake does not become a systemic financial problem. Indeed, there is a strong case for establishing a federal government/industry backstop arrangement that could be activated to deal with such an uninsurable catastrophic risk. As well, this *Commentary* advocates enhancements to the existing survivor-pay, private-sector insurance industry compensation system to lessen accentuating impacts from a crisis event. Meanwhile, companies that insure against this risk and their regulators need to be more transparent about their stress tests. Finally, national authorities should coordinate with their provincial counterparts to assess the broader readiness of the financial system to deal with such a natural catastrophe.

The Right Policy Framework

Well-developed frameworks for analyzing the adequacy of policy responses to potential natural disasters consider three aspects – prevention, insurance and coping capability after such an event (UN 2010). Economic frameworks suggest that incentives matter – for individuals, businesses and for the insurance industry. That means, for example, risk-based pricing, and governments providing frameworks that incentivize the desired behavior.

There are three main categories of losses from a severe earthquake. The first is damage to public infrastructure, where the rebuilding costs will be borne by governments; i.e., the public. The second is damage to private assets financed by the financial system, such as loan losses on mortgaged properties. In this area, government backstops and resolution frameworks are generally well developed. The third loss category – damage covered by the P&C insurance industry, is the focus of this

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Commentary. In so doing, this *Commentary* does not consider in any detail the state of prevention or coping (building codes, disaster preparedness), but focuses instead on the potential grave systemic financial effects.

Clearly, inadequate prevention raises the costs of extreme events. Experience shows that while it is never possible to completely anticipate systemic events with large financial consequences, pre-planning and a range of tools in place beforehand is a better remedial course than relying solely on ad-hoc actions after the catastrophe has occurred.

Disasters such as massive earthquakes have two potential longer-term macroeconomic effects. The disaster, itself, reduces actual output and the economy's productive potential. But renewal efforts can actually build economic capacity, and that can result in medium-term growth and employment that would be higher than if the disaster had not occurred.

As well, having appropriate prevention, insurance and coping mechanisms in place in advance reduces the short-term macroeconomic impact of disasters (BIS 2012) and increases the chance that growth potential is not permanently impaired. Furthermore, studies emphasize the importance of adequate disaster insurance, since such protection usually provides a quicker process to allow business owners and residents to obtain funds to effect recovery.

At the same time, insurance principles stress risk-sharing over a wide-enough population to take advantage of the law of large numbers. Adequate diversification of risk makes reasonable-cost insurance possible. Optimal risk-sharing for very low-probability, high-impact events such as severe earthquakes extends beyond those who might be directly affected. It includes international markets where insurers and reinsurers can cost-effectively cover a basket of uncorrelated catastrophe risks at levels that would not otherwise be possible.

However, for severe catastrophes, the law of large numbers that makes insurance possible does not work at a regional level and may not work even at a national level. This is because earthquake risk is highly concentrated and geographically clustered. These factors explain why it can be difficult for insurers to promote very high take-up among consumers.

Furthermore, government insurance guarantees can create disincentives for private-sector insurers to undertake mitigation through co-insurance, because they assume government will pick up the tab. Such reluctance may result in more of that risk being borne by government than should be. That is the moral-hazard issue. Traditional measures to reduce moral hazard include having the private sector continue to bear a meaningful amount of the risk, ensuring that companies are not guaranteed a bailout regardless of how they run themselves and charging for government guarantees.

There is naturally a trade-off between avoiding systemic consequences and creating moral hazard. That was, for example, a consideration when deciding to put in place deposit insurance or central bank lender-of-last-resort functions for the banking industry. There is a considerable literature on how these backstops can be best designed to lessen legitimate moral-hazard concerns. While backstops caused concern following the financial crisis, few suggest that they should be eliminated. This *Commentary* argues that a properly designed federal backstop arrangement for otherwise uninsurable earthquake risks could complement the existing industry risk-sharing already in place and would not materially pose moral-hazard concerns.

General insurers are not often thought of as posing systemic risk to an economy. However, since availability of insurance is key to the functioning of many businesses, as well as to individuals – homeowners, renters, drivers – the health of the insurance industry is critical to ongoing economic activity. Experience in other jurisdictions suggests that there can be unanticipated wider impacts when general insurers fail. For example, during the collapse of one of Australia's largest general insurers, that company's inability to meet potential medical malpractice liabilities meant that medical services were temporarily curtailed (Australia Treasury 2015).

Following the financial crisis of 2007/08, policymakers have focused on systemic risk to financial and economic systems, with most of the attention on the banking system. The framework for these efforts has been to build resiliency and shock absorbers to minimize the impact of financial shocks on the real economy. At the same time, governments have rightly examined whether their frameworks for resolving serious problems in the banking sector were fit for the purpose. Policymakers have generally found those structures wanting and are making changes. For example, methods to deal with banks in difficulty are being improved, lessening the chance that problems in one institution spread to others. A possible earthquake poses a similar systemic financial risk for the insurance industry and the economy as a whole, and similar remedial efforts are required.

Another issue in assessing government's potential backstop role is determining what risk is uninsurable by the private sector. Insurability requires there be a number of similar possible risk events, independent of each other (allowing the law of large numbers to apply), triggered by specific events with measurable losses if they occur, that are not unduly influenced by the actions of the insured beneficiary (avoiding adverse selection). Earthquakes in a specific region by themselves would not meet some of these law-of-large-numbers requirements, but wider-impact earthquakes or catastrophes globally are more likely to.

As well, insurability can relate to the size of losses. For very large idiosyncratic losses, there may not be a reasonable number of similar uncorrelated risks to permit insurance at affordable rates that people will voluntarily purchase, and that insurers would be willing to provide at available levels of capital. Very large earthquakes are often used as examples of events that test the bounds of insurability (Mehr and Carmmack 1976).

How Would a Severe Catastrophe Play Out in Canada?

Links through Insurers

How would a severe catastrophe like an earthquake pose systemic financial risk? The trigger would be an event with losses beyond the level that the Office of the Superintendent of Financial Institutions (OSFI) requires insurers to provide for; i.e., a one-in-500-year event as of 2022). The systemic linkage through insurers involves the existing industry policyholder compensation organization, the Property and Casualty Insurance Compensation Corporation – (PACICC). It assesses other insurers to meet claims on any failed insurers. As I explain below, those assessments potentially put other insurers in financial difficulty in a severe crisis, thus snowballing the initial impact.

The insurance industry, specifically the PACICC, has done impact analyses of various severe scenarios, and modeled the knock-on effects, to see what the insurance industry could withstand while continuing to meet its obligations to policyholders across Canada. (PACICC 2013). The scenarios focus on major earthquakes in BC and Quebec, but assume various plausible aggregate-loss amounts rather than model the specifics of an individual event. The key findings are:

- Canadian insurers can fully meet claims obligations from a $15 billion disaster shock with no impact on the solvency of well-run, financially healthy insurance companies. This is to be expected, given the OSFI requirements set out below. The OSFI threshold will rise to some $20 billion over the next few years, as higher regulatory capital and reserving requirements phase in. This corresponding to earthquakes expected to be experienced once in a 400-to-500-year period.
- In the $25 to 30 billion range of insured losses, the industry overall appears to have sufficient financial capacity to respond but several smaller, otherwise healthy companies would likely fail. PACICC has effectively handled individual

company failures in the past, but would need to enhance its emergency response capacity for such a catastrophe, as it has never dealt with multiple members in financial difficulty at the same time.

- Beyond $30 billion, the catastrophic losses would exceed the existing capacity of Canada's insurance industry and would exceed PACICC's ability to meet policyholder claims. One or more national insurers would fail. PACICC would have to step in to pay policyholder claims on failed companies, not just those related to their earthquake exposure. To pay for those claims, PACICC's only current option is to assess surviving insurers while it waits to receive money from the liquidation of failed companies and determines ultimate losses. For an event of this size, the assessments on the remaining insurance companies would reduce their capital below regulatory minimums.

Below I examine some of the contributing factors to these results. The overall capacity of the industry to cover severe events is intimately entwined with aspects of how the structure operates. The reality is that, beyond some size, the industry becomes overwhelmed, and PACICC can speed the conveyor belt to the systemic event.

The contributing factors do not affect the essence of the case for a financial arrangement to avoid systemic 'Armageddon', but other improvements could increase industry capacity and thus reduce taxpayers' exposure, and suggest other measures that should be part of any package designed to improve resiliency and enhance claims-paying ability.

Links through the Banking and Housing Finance System

A catastrophe such as a severe earthquake would also have financial linkages through the banking system and Canada's system of housing finance. Some of the effects on banks would be operational risks and are best thought of as business-continuity risks for the banking system. These traditionally have been covered under banks' well-developed, business-continuity plans that receive regular testing and refinement. In some parts of the country, financial system utilities such as exchanges or clearing facilities could be affected by the catastrophic event and that could be a source of knock-on effects to other players who use these facilities.

The catastrophe's main impact through the banking system is likely to be via credit risk effects from uninsured losses on residential and commercial properties. A bank's periodic stress and scenario testing should consider such scenarios to ensure that losses are within the bank's risk appetite. Anecdotal evidence is that major banks do have earthquake events among the suite of scenarios they consider and potential losses are within risk appetite.

Performing such an analysis is also important for major financial institutions such as credit unions that are regionally based. For banks and credit unions, the normal assumption in these scenarios is that insurers will pay out the insured portion of losses. However, once these scenarios include natural catastrophes such as major earthquakes, they would have to take into account that many mortgagees lack earthquake coverage and that mortgage insurance does not cover earthquake losses. In addition the insured portion might not be fully paid in tail risk scenarios as outlined in this paper. Then, credit losses would be materially higher, though likely not solvency threatening.

A significant part of housing finance risk in Canada is insured through the Canada Mortgage and Housing Corporation (CMHC) and several private mortgage insurers. Again, these institutions could take credit losses on their insured portfolios because of the economic effects of a severe earthquake (not due to direct damage as these losses are not an insurable event). It is important that they continue to do appropriate stress/scenario testing and that their regulators, such as OSFI, examine the reasonableness and robustness of these stress tests. Understanding systemic resiliency in these scenarios and determining the appropriate policy response requires fully appreciating the gaps in the

current system, including coverage omissions for severe events and any inability to deal with insurers in financial difficulty.

Gaps-The Current Canadian Situation

Is Risk Adequately Covered?

Many individual Canadians and businesses are exposed to earthquake and other catastrophic risks. In BC, there is at least a 30 percent chance of a significant quake in the next 50 years (ICLR 2010). The greatest damage would come from a strong quake in shallow waters off the BC coast. Related fire damage and the possibility of tsunami damage would increase the potential disaster.

But BC is not Canada's only earthquake-prone region. There is also a sizable earthquake risk in the Quebec City-Montreal-Ottawa corridor – a 10-to-15 percent chance according to Natural Resources Canada – that is often not recognized in policy discussions. And experts say that Quebec would be less resilient than BC due to its great number of older high-value buildings and aging infrastructure (Air Worldwide for IBC 2013). Overall, some 40 percent of Canadians live in areas classified as "moderate" or "high" risk. From an economic perspective, this is a classic low-probability, severe-impact tail-risk event. However, from a public-policy perspective, it pays to think of a severe earthquake as a certain event whose timing is uncertain, and plan accordingly.

Insurance industry estimates put the expected loss from a severe magnitude 9.0 earthquake off the coast of Vancouver in the $75 billion range with some $20 billion insured (Air Worldwide for IBC 2013 and PACICC 2013). A St. Lawrence River Valley event between Montreal and Quebec City at magnitude 7.1 was estimated to have costs in the $60 billion range with insured losses around $12 billion. Leading geologists have expressed fears that more moderate events close to Montreal could cause even worse damage as a result of the city's aging infrastructure.

Current industry capacity is in the $30-$35 billion range, which appears manageable for a range of events, given the results of periodic scenario tests reported to OSFI for a combination of West Coast and St Lawrence events (OSFI 2015). These confirm that the industry is well able to cover the currently assumed one-in-430-year severity earthquake (some $35 billion). In addition, these tests show the vast majority of industry members have adequate financial resources, today, to cover the higher 2022 OSFI requirement related to a one-in-500-year severity event.

However, there is no guarantee that actual experience would not be more catastrophic than these arbitrarily determined "severe" scenarios. That extreme tail possibility is the source of the systemic risk. For example, more catastrophic West Coast events have been modelled with insurance claims of up to $95 billion (PACICC 2013).

It must be emphasized that all these analyses are based on estimates that themselves have a significant margin for error. Thresholds from several years ago are higher now, models have factors that are not always adequately considered and recent experience worldwide is that event surprises occur with more severity than previously thought possible. That does not diminish the value of the analysis, but does reinforce the need to regularly plan and be prepared for extreme possibilities.

Gaps in Insurance Coverage

Industry data indicates that 80-to 90 percent of commercial and industrial enterprises purchase "all-hazard" insurance coverage that includes earthquake damage. But policies differ, so it is important for policyholders to understand coverage, including the extent of property damage and business interruption coverage.

On the personal side, some 60 to 65 percent of southwest BC homeowners are covered by earthquake insurance, with some 70 percent coverage in Victoria and 55 percent in Vancouver. Coverage by renters is much less. There is almost

no coverage for tsunami. Again, the extent of consumer understanding of coverage is debatable. This is important as deductibles, for example, can be large, can differ widely, and consumer awareness is likely low. However, this coverage level compares favourably to other jurisdictions – for example, the take-up rate in California and Washington is just in the 10-to-12 percent range (Insurance Information Institute January 2015). (These rates are down considerably from the 30 percent range achieved two years after the major 1994 southern California Northridge quake.)

While insurance coverage seems favourable on the Canadian West Coast, only about 2 percent of other Canadians have earthquake coverage – and that includes those in the Quebec-Montreal-Ottawa corridor. That rate appears inadequate, given the risks noted above and the benefits of insurance from a macroeconomic perspective. Studies indicate that the major reason for consumers, generally, not buying insurance is underestimating the risk (Wharton 2008). In this regard, it is striking that much of the mainstream Canadian media commentary on the earthquake issue focuses on BC, to the exclusion of other parts of the country.

Actions to increase earthquake risk-awareness in central Canada, as recommended in this *Commentary*, would clearly increase the demand for earthquake insurance. Meanwhile, investing in mitigants in the form of more resilient buildings and renewed infrastructure makes sense. Naturally, more insurance coverage would add pressure on existing insurers, as the regulatory-mandated probable maximum loss they would need to cover in their reserves and capital would automatically increase. The result would likely be an additional gap between potential claims and industry capacity in an extreme event. The estimates of industry capacity cited here to deal with catastrophes are based on existing insurance coverage. However, it would be desirable for industry and government to model scenarios where insurance coverage in eastern Canada was higher.

Dearth of Information on Pricing and Affordability

In terms of insurance costs, there is no public Canadian data that show trends in pricing or coverage. Nor is there regular survey data on consumer behaviour and attitudes toward risk. While it is not clear that pricing is a barrier to insurance take-up, the current lack of information is an obstacle for public policymakers. It should be addressed.

Furthermore, given the strong role of actuaries in insurance product design, one would expect a reasonable degree of risk-based pricing. However, it is not possible to verify the extent to which pricing across the country for catastrophe coverage does reflect relative risks.

Industry Financial Capacity is Capped

The industry currently has claims paying capacity for earthquake coverage somewhat higher than regulatory requirements, as set out above. Industry scenario analysis indicates that, for events with losses materially above this level, many insurers would fail and the industry as a whole would be unable to meet claims, including earthquake claims and business and homeowner claims more generally.

In addition, the insurance industry's financial capacity to satisfy claims relies heavily on reinsurance contracts. According to information reported to OSFI, scenario tests suggest that up to 80 percent of national companies' claims-paying capacity is met through reinsurance, where the primary insurer transfers some of the premium to another global insurer in exchange for that global insurer covering part of the risk. This approach helps Canadian insurers access international financial capacity that is priced on a global sharing of catastrophe risk. However, catastrophe insurance and reinsurance contracts can be quite complex, and payment by reinsurers is not automatic. It is not uncommon for there to be a considerable difference in what primary insurers think their likely collectible is and what is ultimately recovered. In other words,

industry capacity may be less than what is currently assumed. This might especially be the case in a scenario where an earthquake simultaneously affected the BC coast and parts of the US.

As well, in recent years, the global reinsurance market has been "soft," meaning there is excess capital and reasonable pricing. When the market hardens, capacity will be less and reinsurance more costly.

Crisis Resolution System Needs More Flexibility to Help Dampen Shocks

The insurance industry created the PACICC in 1988 as a consumer-protection measure to deal with insurers that fail. It honours policyholder claims in failed companies up to certain limits and collects any losses, after the fact, through assessments on other member companies. Virtually all industry members licensed to write insurance protected by PACICC must join.

PACICC is a private-sector organization not empowered to resolve financial difficulties before failure and does not receive any federal government financial support or guarantee, unlike the Canada Deposit Insurance Corporation (CDIC). The PACICC is a post-funded resolution mechanism, in contrast to pre-funded mechanisms such as the CDIC. The PACICC board includes independent members, and they alone are involved in certain resolution decisions. That means there is less potential for conflicts of interest in how the organization deals with failures.

Still, improvements could increase system resiliency. In particular: PACICC is limited in its experience in dealing with companies in financial difficulty. Essentially, unlike the CDIC, PACICC has only intervened after a company has failed. It takes over *all* the covered claim liabilities of a failed company, then assesses other industry members for the estimated compensatory payouts. Then, it must wait for liquidators and the courts to value and distribute assets of the failed company, a process that typically takes from two years to ten years.

Accounting rules require that the up-front present value of PACICC assessments on an otherwise healthy company be recognized as a liability and, thus, be deducted from capital. This increases the short-term pressure on healthy companies and increases any knock-on effects.

In the case of a catastrophe, a liquidity problem can become an industry-solvency crisis as assessments on healthy companies turn out to be too much for them to bear and maintain solvency requirements. As well, PACICC's need to pay *current* claims over a short time horizon leads to material pressures on other companies, a liquidity event that becomes a solvency problem.

The P&C industry does not have experience with a "resolution" authority, as is the case with CDIC and the banking industry. As a result, PACICC has not pursued remedial measures that might be lower cost and have less systemic impact. Specifically, for example, PACICC has not isolated the "problem" business area of a company in financial difficulty, say its earthquake section, move it into a separate entity and work out financing for that liability while continuing to operate the remaining healthy business separately. Such remedial action could reduce the assessments the PACICC would have to make on otherwise healthy companies in a crisis.

Also, PACICC is limited in providing emergency funds for a company in financial difficulty where that might be a lower-cost option than liquidation (the same way that the CDIC can provide guarantees for deposit-taking institutions in financial difficulty). Furthermore, PACCIC doesn't have the clear power, authority and resources to execute other resolution plans such as forced sales or act as a bridge insurer if an immediate buyer is unavailable.

While PACICC can borrow, it has never sought reinsurance (or issued catastrophe bonds) to cover the potential of catastrophic events. This might in some circumstances reduce immediate assessments that cause knock-on effects and expand the range of events that the industry could handle by itself.

However, such reinsurance would not weaken the case for a last-resort, risk-sharing arrangement with government. Beneficial impacts could occur, for example, if PACICC was able to lessen liquidity pressures from a severe event through market transactions. A related possibility would be for PACICC to borrow from the federal government (as again, is the case with the CDIC), which might offer longer-term financing and thus spread out the costs of severe events. But contingent financing arrangements in the event of a catastrophe are not in place.

Resolving these issues is important to improving systemic resiliency, but is not a substitute for having in place public/private arrangements to cover the most severe possibilities and, thus, address the ultimate systemic risk. Improving resiliency by addressing the issues above can, however, lessen the likelihood of a public backstop arrangement being called on and can reduce the costs in the unlikely event it is triggered.

Needed: More Transparency and Resiliency

OSFI requires insurers to maintain capital for various contingencies, and those with earthquake exposure are explicitly obliged to report annually on their capacity to handle a large quake. It also requires those companies to estimate their probable maximum loss and to show coverage for an earthquake with the severity expected to be experienced over a specified period. Coverage can come from a combination of reinsurance, dedicated earthquake reserves and from up to 10 percent of the insurer's capital (see Guideline B-9, OSFI 2013).

This system started in 1998 with the regulatory target being coverage for a one-in-250-year event. Now, regulators are gradually making the test more severe with the goal of a one-in-500-year event to be covered by 2022. The current once-every-430-years standard would be a quake producing losses of roughly $35 billion. Major quakes in other developed jurisdictions have produced similar damage. The California Northridge quake in 1994 was the costliest in US history with US$42 billion in total property damage and US$15.3 billion in insured losses (RMS 2004).

Overall, the Canadian insurance regulatory framework is a world leader in a number of respects. For example, rating agencies that now factor severe earthquake risk into their assessments typically use only a 100- or 200-year severity event, less than half the Canadian standard. The catastrophic 2013 Alberta floods that forced the evacuation of 75,000 people in Calgary among other cities was Canada's costliest insured natural catastrophe until then, yet resulted in only some $1.8 billion in claims, well below the industry's capacity (IBC 2014). It is too early to assess the costs of the Fort McMurray, Alberta wildfire disaster – though it is likely to be the costliest. Early rating agency estimates reported in the press (Globe and Mail 2016) are in the $2 to$6 billion range, still well below a severe earthquake.

The current level of industry risk-sharing appears reasonable compared to many other earthquake-prone jurisdictions. In Canada, the insurance industry is well on its way to having the capacity to handle a one-in-500-year event. In California, earthquake coverage is set to handle a one-in-545-year event, but that applies only to residential insurance (California Earthquake Authority 2015). Again, Japanese earthquake insurance take-up was around 28 percent at the end of 2013, compared to the 60-to-70 percent in B.C. But the share of Japanese insurers in total claims paying capacity is much less than in Canada (Japan Ministry of Finance 2015).

Reinsurance covers about 60 percent of Canadian insurers' overall earthquake coverage (OSFI 2015), but there are potential downsides to this otherwise cost-effective way to spread risks and access coverage. It adds a level of counterparty risk – will the reinsurer pay in a timely manner? – and also means that Canada is exposed should international reinsurance capacity be constrained in the future for any reason.

OSFI also sets sound risk-management practices and requires boards to receive annual reports on each insurer's capacity (OSFI 2013).

Insurers with earthquake exposure in either BC or Quebec are required to estimate probable maximum losses; others may use a standardized approach. Models have, at their core, the insurer's book of business linked to geographic location and to loss assumptions based on seismological maps. Still, firms are not required to have these models approved by regulators, and OSFI does not review these models in detail on a cycle. OSFI should not be approving models, but needs to ensure that its review of industry practice is adequate. Model-based companies have almost 90 percent of their required capacity met through reinsurance (OSFI 2015).

The reliability of these earthquake models rests on the reasonableness of the data and the assumptions used. Another factor is the extent to which the model incorporates realistic scenarios and has buffers for conservatism. In the banking sphere, following the 2007/08 financial crisis, regulators have focused much more on banks' use of models, because of these kinds of factors. Similarly, regulators need to focus on the reasonableness of earthquake models.

There are anecdotal reasons to question whether current assessments are sufficiently robust. For example, some 60 percent of industry models operate only at the postal-code level to estimate earthquake exposure, while more advanced approaches use specific address data (OSFI 2015). More granular data is likely to lead to more accurate estimates of losses; insufficient granularity reduces the ability to price correctly for risk.

Public survey data on earthquake exposure and coverage is not readily available from companies or OSFI. While OSFI's stress-test results are not published, high-level feedback is provided to industry for overall results and individual companies get feedback specific to them, particularly if their results are not satisfactory. OSFI has made brief public comments on their stress-test results, but there is room to enhance that without raising company-specific competitive concerns.

Insurance legislation has long required independent actuaries to perform a variety of stress tests to see how the company's capital would be affected by disasters and to report the three most severe scenarios to the board of directors. (Earthquake may not be one of the three scenarios for any individual company.)

Meanwhile, the provinces are responsible for regulating the insurance industry. None require consumers to purchase catastrophe insurance. Indeed, none even require the industry to offer such insurance. Neither does CMHC mortgage insurance require earthquake coverage as a condition of obtaining a CMHC guarantee, nor does it even require that this coverage be offered to homeowners.

Lastly, it is relevant to note that the federal and provincial governments are both involved in disaster relief should there be a severe event (see the Disaster Financial Assistance Arrangements and Federal Emergency Response Plan, for example). They would be on the hook for significant sums in the case of severe earthquakes. Appropriate disaster response is a very important mitigant in starting recovery following a severe event. But it cannot be a mitigant for the systemic financial impacts examined in this *Commentary*.

Further Involving Financial Markets – No Panacea

Policymakers often ask what the scope is for using financial market instruments to deal with issues raised in this *Commentary*. And involving international markets is already core to the existing system.

Insurance companies and international reinsurers provide claims-paying capacity by committing capital that is essential for insuring against catastrophe risk. In 2015, global insurer Munich Re reported US$90 billion in total industry catastrophe

losses of which US$27 billion was insured. The average annual insured losses over the past 10 years were US$56 billion and over the past 30 years was US$34 billion.(Insurance Information Institute 2016). The global industry has successfully financed the costs of large catastrophes.

Globally, it has long been understood that, under certain conditions, risk-sharing could be further broadened and its capacity to meet insurance claims increased by direct risk sharing with investors through markets. Financial instruments have been developed such as insurance securitizations and catastrophe bonds (Cat bonds) to attract potential investors (see Mutenga and Staikouras 2007 for a discussion of alternative financing instruments). Cat bonds transfer a specific set of risks from issuers directly to investors. The issuers pay a coupon (often a floating rate over the LIBOR) and principal on the Cat bond's maturity provided the specified event has not occurred. If it does occur, then the principal is forgiven.

However, the bonds are risky (usually BB, or below investment grade) and have maturities of three years or less. Investors include asset managers, funds developed specifically to hold a portfolio of Cat bonds and pension plans. Investors can use Cat bonds for diversification (within the catastrophe sphere or across broader asset classes, given that their returns are likely largely uncorrelated with other investments). Unfortunately, the global stock of Cat bonds in 2015 was low, at approximately US$25 billion, with annual issuance in the US$8 billion to US$9 billion range (Artemis 2016).

Conceptually, sharing risk through large diversified global reinsurers offers the same benefits as Cat bonds, in that reinsurers are also pooling a variety of risks and intermediating between those who put up capital and primary insurers. Which route is better – reinsurance or direct market instruments – will depend on the efficiency of reinsurers versus market mechanisms for diversifying risk, the ability of the two different processes to identify and efficiently price risk and on there being adequate liquidity in Cat bond markets.

In certain markets, reinsurance may not be available. As well, reinsurers themselves may issue Cat bonds or use other mechanisms such as insurance securitizations to offload risk directly to investors and increase the reinsurer's capacity to undertake other business.

Indeed, the main Cat bond issuers to date have been global insurers and reinsurers looking to attract more capital and/or offload some of their exposure. Mexico has been the only sovereign to tap this market directly for earthquake and hurricane risk (Artemis 2016). In June 2014, the World Bank issued its first Cat bond (US$30 million) linked to a range of natural disasters (hurricane, cyclone and earthquake risks) in 16 Caribbean countries (World Bank 2016). This allowed the World Bank to provide reinsurance to the Caribbean catastrophe risk-insurance facility, which is a pooling mechanism among these countries designed to limit financial exposure for any one of the countries. The World Bank has also played a role in setting up a common documentation platform for Cat bond issuance and can act as an arranger. (This capability was used by Mexico.)

There is no evidence that this Cat bond market offers an additional major opportunity that is not being or could not be exploited, directly or indirectly, by Canadian companies. And if the federal government offered some form of backstop arrangement for uninsurable catastrophic risk, it is not clear that it would have any advantage in trying to lay off part of that risk in international markets. Doing so might adversely affect existing industry reinsurance arrangements, as Ottawa would be competing for investors' and reinsurers' appetites for Canadian risk.

How are other Jurisdictions Addressing Gaps?

Globally, there is a wide range of government involvement in catastrophe insurance. Overall, Canada is an outlier with no federal financial involvement to either cap exposure or provide or even facilitate backstop arrangements for very severe earthquake-related events.

Yet, the federal government has provided financial protection mechanisms for other severe events. As noted above, deposit insurance and emergency liquidity arrangements for the banking system are designed to reduce systemic risk. As well, Ottawa backstops nuclear operators for losses above a $1-billion liability limit (and similarly for offshore oil spills).

It also has a contingency guarantee in place for private mortgage insurers to put them on a more even footing with the CMHC (which is a Crown agent) in competing for mortgage insurance business. These arrangements are examples of government underwriting severe tail risk beyond what private markets can assess, price or absorb.

A few countries, such as Turkey and New Zealand mandate that insurers are required to offer, and consumers are required to buy, catastrophe insurance (GFDRR, 2011). In New Zealand's case, earthquake insurance is part of homeowner policies. That does not appear desirable or necessary in Canada, as private provision seems broadly to be working, and experience elsewhere indicates that mandating insurance may not achieve desired results. For one thing, effective incentives for compliance are hard to design.

Other jurisdictions require insurers to offer catastrophe coverage, but consumers are not required to buy it (e.g., California, Japan). While offering catastrophe insurance could increase consumer awareness, the evidence that this leads to increased purchased protection is mixed at best, given the low take-up rates reported above. But this deserves further study by governments and industry to determine if it might help in Canada.

Meanwhile, some countries offer state-backed financial reinsurance to primary insurers to counter the potentially large financial impact of catastrophes. In France, the state reinsurance entity is government guaranteed and offers unlimited reinsurance. In New Zealand a government agency assumes the private earthquake contracts, uses premiums to build up a fund, purchases reinsurance and provides a government guarantee if claims exceed the value of the fund plus reinsurance, which occurred in 2012.

In other nations, state backing exists but is limited. Caribbean countries have set up a mutual risk-pooling arrangement, but the payouts to any one country are limited to approximately US$100 million per year, per hazard. In Japan, there is an explicit pre-arranged public/private sharing of financial risk, subject to a total cap. The total liability is capped at ¥7.0 trillion (C$82 billion) – if total claims exceed this, all claims are prorated by law. The first ¥100B (C$1.2 billion is borne totally by industry through a quasi-public reinsurance company owned by the industry with which all insurers must reinsure their earthquake exposure. The next approximately ¥260 billion (C$3.1 billion) is shared 50:50 between industry and government while amounts over that up to the overall limit are borne solely by government (Japan Ministry of Finance 2015). These arrangements greatly reduce, or eliminate, industry-wide solvency risk, so that financial stress on the insurance industry does not amplify the impact of severe catastrophes.

The US federal government does not offer a federal backstop,[1] although California, the state most exposed to earthquake risk, has put in place a risk-sharing approach through the California Earthquake Authority (CEA). It is a publicly managed, not-for-profit, privately funded entity set up as tax exempt and bankruptcy proof. The CEA was created, in part, because the 1994 Northridge quake taxed insurers' financial ability to meet claims, leading to restrictions in insurance availability for new homes, thus threatening the housing market (California Earthquake Authority 2015).

1 At the federal level, the US has recognized that uninsurable risks such as terrorism do require a government backstop.

The CEA issues standardized residential policies (mini-policies) through private insurers, receives premiums (less a commission to insurers) and pays claims. All homeowners must be offered catastrophe insurance, and some three-quarters (76 percent) of California earthquake insurance is issued by the CEA. The CEA currently has about US$11 billion in claims-paying capacity, through capital contributed by industry ($777 million), reinsurance and investment of premiums (CEA, 2015). This is enough for a one-in-545-year event (CEA 2015). Legislation provides that if an earthquake causes losses larger than the CEA's claims-paying capacity, policyholders may receive only a prorated portion of covered losses.

In summary, international experience suggests that the systemic financial impact of severe events needs to be explicitly considered in Canada, with more protective measures than exist today. Risk-sharing with industry is important to preserve. We can also learn from the multi-pronged approaches in some jurisdictions that limit the impact from severe events for the industry and/or provide government financial backstops.

Options and Recommendations

A gap exists in Canada between the potential losses from a severe event and the insurance industry's capacity to withstand such a catastrophe. Since extensive severe catastrophic events are not theoretically insurable by private markets, it is reasonable that the whole collectivity, through the federal government, assume the role of insurer or reinsurer of last resort. Such government responsibility would provide an incentive for authorities to keep mitigation measures (e.g., building codes) as up to date as possible. Since the benefits of mitigating systemic risks accrue to society at large, not just to one industry or part of the country, many jurisdictions authorize government intervention to mitigate or limit the impact of catastrophic events. Doing nothing would leave those costs above some threshold from a major earthquake catastrophe to be borne by those directly affected by the damage, existing insurance, and federal/provincial disaster relief. This, however, exposes the economy to unnecessary systemic risk and long-lasting, avoidable, economic impacts.

But, as part of any Canadian reform package, it is important to bolster the PACCIC to deal with insurance industry problems and reduce systemic impacts from severe catastrophes. This would reduce the likelihood that a federal financial commitment would be triggered and, if triggered, have minimum costs. Having more tools available in advance to deal with catastrophic events would reduce post-catastrophe disaster claims.

Should insurers be asked to provide more financial security? This would involve further raising the OSFI threshold for the severity of events that companies have to provide for in capital, reinsurance and reserves. The trade-off in this approach is that raising the cost to insurers of providing existing coverage could backfire by reducing the supply of affordable earthquake cover, thus exposing the economy to added macroeconomic risk. Nor could this approach cover all tail-risk scenarios that would pose systemic risk – so the case for a government backstop partnership would remain.

Regardless, there are gaps in the current recovery and resolution system that need to be addressed. Lessons from the global banking crisis and from Canada's ensuing resolution regime could be applied to the P&C industry to add resilience and raise its capacity to cover extreme events without creating systemic risk. Such an approach would also reduce the exposure to the federal government that might arise from any backstop arrangement. Some relatively easy fixes include:

- Strengthen PACCIC so it can intervene before insurance companies in financial difficulty become insolvent. For example, PACCIC should have the ability to isolate earthquake business from other insurance business. This might require legislative changes, but unless PACCIC has a federal guarantee similar to that of the CDIC, it will be limited in the financial assistance it

can provide to resolve an imminent insurance industry and, possibly, a broader economic crisis;

- Ensure PACCIC has the capability to borrow to reduce its liquidity needs in a crisis. This would bridge more effectively the time between paying claims against failed companies and when assets to meet those claims are available. It would also lessen the PACCIC's necessity to 'up-front' assessments on the insurance industry, thus lessening knock-on financial effects that could cause a systemic crisis. In this vein, the possibility of borrowing from the federal government should be explored; and
- PACCIC should run its scenario models with these structural changes included to examine how much that could increase resilience to extreme events.

Even with these needed changes, however, there will still be some potential earthquake event beyond whatever regulatory threshold exists where the industry financing capacity becomes so stretched that there is a systemic risk. So the case for backstop federal involvement remains.

Government's Role

The insurance industry has raised the question of the appropriate role for government in mitigating catastrophic loss. For illustration, a federal arrangement might address the following situations:

A federal last-resort backstop guarantee could kick in beyond an industry-wide trigger of expected losses, say those associated with a one-in-500-year earthquake – currently approximately $30 billion to $35 billion. This loss estimate would be updated periodically, and the trigger could be set somewhere in excess of the one-in-500 threshold to promote further industry risk-sharing.

It would be a contingent commitment by the federal government to pay unfunded claims liabilities above the trigger amount. As a contingent liability it would be necessary for the government to have parliamentary authority as part of the annual expenditure authorization process to make the payment. But there would only be an impact on the federal deficit and debt in the extremely rare event that payments are actually made.

Attention would need to be paid to the detail design of how the contingent guarantee would work in practice, in order to reduce moral-hazard impacts. For example, insurers should not automatically be paid in full for all claims above the threshold in a bailout. As an alternative, insurers could be allocated funds based on the ratio of their earthquake claims liabilities to total industry claims liabilities nationally. Companies that were less capitalized relative to their exposure than the industry overall could still suffer losses and fail. That approach preserves incentives for companies to be well managed and well capitalized. As a result of the contingent guarantee fewer would be in a precarious position and any losses that would have to be covered by the remaining healthy companies would be greatly reduced, thus minimizing the systemic risk.

Another important issue is how such a backstop arrangement would affect the behavior of market participants. As long as current regulatory requirements are in place, industry players who are offering catastrophe coverage will have claims-paying capacity to cover the one-in-500-year event. Because the federal financial contribution in this situation is linked to industry claims, not to claims-paying ability, there is less chance of the guarantee leading to laxity in underwriting or risk-management standards for individual companies.

The insurance industry has claimed that having federal government backstop arrangements in place could assist in increasing the demand for coverage for private insurance.

This effect is unclear from the demand side. Potential consumers might think that a backstop increases the value of an insurance policy, but there is little evidence that consumers factor such solvency risk assessments into decision making.

However, a properly designed backstop arrangement might lessen the chance that industry players withdraw from the market, or limit supply of insurance coverage because of uninsurable tail

risk. That is because a federal backstop reduces or eliminates the solvency risk for insurance company shareholders (through no fault of their company).

This supply-side effect is hard to quantify but is likely real. For example, in California, when disaster-scenario risks for companies were highlighted as a result of the Northridge earthquake (which threatened the solvency of several insurers), there was a material supply contraction in the marketplace (RMS 2004).

In lieu of unfunded direct contingent guarantees, the federal government should examine other design options in providing a backstop, including an arrangement where it pays only part of a tranche of excess claims in a catastrophe, or provides that a portion of any costs from triggering the guarantee arrangements would be charged back to industry but over a longer time frame. Cost-sharing of this nature reduces the government's exposure and reduces moral-hazard issues. Whether these sorts of options reduce systemic effects, which can be determined only by detailed modelling in cooperation with industry, depends on how much they deal with the PACCIC's liquidity issues in a crisis and how much they lessen PACCIC crisis assessments on otherwise healthy companies.

Ottawa has traditionally not wanted to make PACCIC a crown agent like CDIC with a full government guarantee. Doing so would have broader implications and moral-hazard issues. However, the federal government could consider putting in place arrangements in advance that give it the ability to provide financial assistance directly to PACCIC in case of severe events, which would increase PACCIC's ability to solve problems with less knock-on impact. As noted above, this might involve providing long-term emergency liquidity financing in a crisis so PACCIC has less need to immediately assess otherwise healthy companies. That would reduce liquidity pressures and the chance they become system-wide solvency impacts. Having that authority in advance would make it more possible to use this as a tool in a crisis.

It is not clear that the provinces have a natural role in any such backstop arrangement. The case for a national plan is based on the threat that a serious earthquake, regardless of where it occurs, has system-wide consequences for the entire country and economic activity more generally. That suggests the need for a federal role, an approach likely to be more practical than trying to negotiate apportionment of costs among levels of government and regions of the country.

Conclusions

The federal government should address the issue of inadequate financing in the case of a catastrophic natural disaster such as a major earthquake in BC or the Quebec-Montreal corridor. Ottawa should satisfy itself, together with provincial regulators, that stress testing of banks and systemically important credit unions and exchanges adequately accounts for catastrophes.

A federal emergency backstop arrangement for property and casualty insurers, properly designed, would minimize the systemic financial impact resulting from such a catastrophic and likely an uninsurable event on those affected and on the economy at large. The moral-hazard implications appear small compared to the benefits of avoiding serious systemic risk. The backstop arrangement should, however, apportion costs, including a possible tranche of further contingent risk-sharing with industry in a way that lessens moral-hazard issues.

As part of any reform package, the initiative should deal with structural weaknesses in existing private-sector resolution arrangements for the property and casualty insurance industry. However, confronting these issues does not obviate the need for federal involvement in risk-sharing and backstop in the case of extreme events. Such enhancements would further strengthen industry resiliency and thus reduce, potentially significantly, the likelihood of any systemic backstop being triggered – and reduce the costs if it were. The

reforms should allow PACCIC to intervene earlier to achieve lower-cost and less-systemic resolution of failed insurers in a crisis and enhance PACCIC's ability to finance policyholder claims of failed insurers, lessening spillover effects on other insurers.

In any event, insurance industry bodies, as well as the federal and provincial governments, should undertake awareness programs to enhance homeowners' understanding of catastrophe risks. This should encourage Canadians to evaluate the merits of disaster insurance coverage, particularly in the Quebec City-Montreal-Ottawa corridor where such insurance penetration is far too low. Requiring private insurers to offer catastrophe coverage as part of homeowners' and renters' policies, as is done in some jurisdictions, or requiring the CMHC to offer such coverage with an explanation of risks in certain regions should be explored.

As well, the insurance industry, under active OSFI supervision, should further develop its models for setting aside adequate capital and claims-paying capacity. Regulators should ensure there is an adequate degree of conservatism and that models are as up to date as possible. OSFI should regularly assess the adequacy of major insurers' models, as they have done in the banking industry.

Finally, the insurance industry and OSFI should greatly enhance their publication of data on risks, financial capacity as well as on pricing and availability of catastrophe cover, consumer attitudes to catastrophic risk and on penetration of insurance coverage.

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